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10/708,748

03/23/2004

Wei Lu

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SUITE 304

ANNAPOLIS, MD 21401

EXAMINER

JOHNSTON, PHILLIP A

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Application/Control Number: 10/708,748  
Art Unit: 2834

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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

Application Number: 10/708,748  
Filing Date: March 23, 2004  
Appellant(s): LU ET AL.

\_\_\_\_\_  
Duane N. Moore  
For Appellant

**EXAMINER'S ANSWER**

This Examiner's Answer is submitted in response to the appeal brief filed 1-18-2008 appealing from the Office action mailed 8-23-2007.

**(1) *Real Party in Interest***

A statement identifying the real party in interest is contained in the brief.

**(2) *Related Appeals and Interferences***

A statement identifying the related appeals and interferences, which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

**(3) *Status of Claims***

The statement of the status of the claims contained in the brief is correct.

**(4) *Status of Amendments After Final***

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) *Summary of Claimed Subject Matter***

The summary of the invention contained in the brief is correct.

**(6) *Grounds of Rejection to be reviewed on Appeal***

The examiner agrees with the statement of the grounds of rejection to be reviewed, as set forth in the brief.

**(7) *Claims Appendix***

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) *Evidence Relied Upon***

U.S. Patent No. 5,574,280 to Fuji

U.S. Patent Pub. No. 2004/0021076 to Kadyshevitch

**(9) Grounds of Rejection**

The following Rejection is set forth in a prior Office Action, mailed 8-23-2007.

***Claims Rejection – 35 U.S.C. 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-3, 6-8,10,13-15,17,19, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 5,574,280 to Fuji, in view of Kadyshevitch, U.S. Pat. Pub. No. 2004/0021076.

5. Regarding claims 1, 8, and 15, Fuji teaches a method of inspecting topographical features of the top layer of a structure in Figure 4 below, that includes:

(a) a reaction organic metal gas 14 is blown onto the surface of semiconductor device 5 (surrounding the structure with a precursor metal gas). Col. 3, line 28-37;

(b) using angled energy beam 19 ( an electron beam) to irradiate the gas/surface (directing an angled electron beam at the structure). Col. 2, line 40-49, and Figure 4 below,

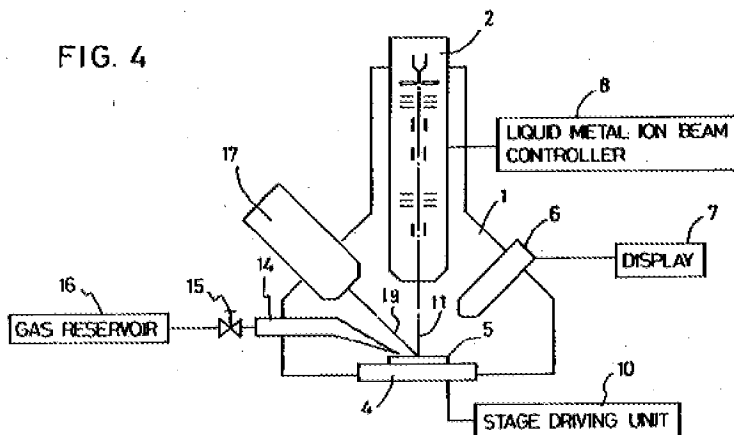
(c) generating secondary particles Col. 4, line 1-8, wherein the secondary beams have less energy than the angled electron beam, which is an inherent property of secondary electron generation,

(d) the electron beam reacts with the gas to form a hard fusing metal film using the energy beam CVD method ( the secondary electron beams break down said precursor metal gas to form a metal coating on said structure). Col. 2, line 40-49;

(e) Sputtering away a portion of the surface with ion beam 11 (directing an ion beam at said structure to form a groove within said top layer of said structure). Col. 2, line 50-54,

(f) forming a hard fusing metal on the surface so that the ion beam will have no effect such as auto-doping (wherein said metal coating is adapted to protect said topographical features from said ion beam. Col. 2, line 27-39;

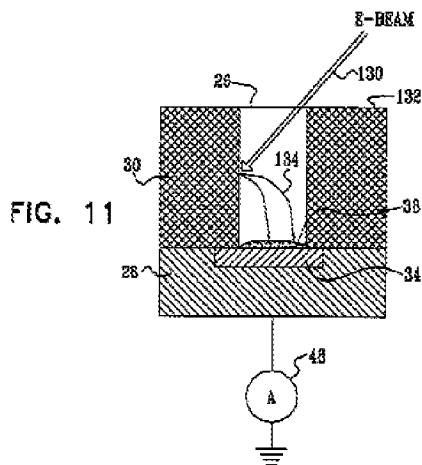
(g) An image of the sample 5 is displayed on a display 7 based on the signals of the detector 6. (inspecting said topographical features exposed by said groove in said top layer of said structure). Col. 4, line 4-8.



6. Fuji fails to teach an angled beam selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron

beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features.

7. Kadyshevitch teaches angled irradiation of contact hole 26 by an electron beam 130, where the tilt angle of beam 130 is preferably chosen so that a majority of primary beam electrons do not strike the bottom of the contact hole. See [0198] and Figure 11 below.



8. Kadyshevitch modifies the Fuji method to provide a particle beam that radiates the surface of the sample at a non-normal angle, so that, the energetic primary beam strikes the side walls of the contact holes, rather than the bottom, and since the secondary electrons emitted from the side walls and upper edge of the contact holes are driven down toward the bottom of the holes, where they will have less effect on the bottom since they are substantially less energetic than the electrons in the primary beam.

9. Therefore it would have been obvious to one of ordinary skill in the art that Fuji would use an angled electron beam of Kadyshevitch so that more of the charged particles strike the side walls than strike the bottom of the contact hole.

10. Regarding claims 2,3,7,10,14,17, and 20, Fuji as described above regarding claims 1,8, and 15, teaches directing said angled electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features, and comprises tilting a stage that at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure (Note also Figure 6b in Fuji).

11. Regarding claim 6,13, and 19, the use of an electron beam having an energy level of approximately between 100 and 10,000 electron volts is well known in the art, See also [0163] in Kadyshevitch.

***(10) Response to Argument***

The following is the Examiner's Response to Arguments contained in the Appeal Brief filed 1-18-2008.

**Applicants Argument 1**

***A. Regarding the §103(a) Rejection of claims 1-3 and 8-11***

Applicant states that, "Because the "secondary electrons can be forced down to the hole bottom, rather than moving out of the hole" (Kadyshevitch, para. 0200), they are not free to react with any precursor gas (such as that in Fuji) to form any metal coating. Therefore, Appellants submit that Kadyshevitch teaches away from the claimed invention."

"Accordingly, Appellants submit that because the secondary electrons of Kadyshevitch "secondary electrons can be forced down to the hole bottom, rather than moving out of the hole", they are not free to react with any precursor gas to form any metal coating. Therefore, it is Appellants' position that the proposed combination of Kadyshevitch and Fuji does not teach or suggest the claimed features of directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure as defined in independent claims 1, 8, and 15. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection."

The examiner disagrees

The applicant is respectfully directed to Kadyshevitch paragraph [0163], which states; the electron energy of the electron gun may be variable, typically between about 100 and 5000 eV, so as to cover both positive and negative charging domains of the materials in wafer 20. Kadyshevitch also explains in paragraph [0163] that, the positive charging domain is the range of electron energies in which the total yield of secondary and backscattered electrons from the surface layer is greater than the primary electron beam current, while the negative charging domain is the range in which the total yield is less than the primary beam current.

One of ordinary skill in the art would interpret from the above that, Kadyshevitch discloses irradiating an electron beam at an angle to strike a sidewall, and by using a



negative surface charge, the low energy secondary electrons generated by the angled beam are driven to the bottom of a hole; however, one of ordinary skill in the art would also interpret that Kadyshevitch discloses using an electron beam to charge the sample surface either positively or negatively, and that a positively charged surface would not drive secondary electrons to the bottom, but would provide an attractive potential to the secondary electrons drawing them to the surface and making them available for dissociation of a metal gas flooding the surface. Therefore, one of ordinary skill in the art would conclude that the Kadyshevitch invention does not exclude or teach away from the use of positive charging, but merely shows certain advantages that can be obtained by negative charging.

## **Argument 2**

### ***B. Regarding the §103(a) Rejection of claims 6, 13, and 19.***

The applicant states that " Appellants submit that the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts" as defined in dependent claims 6, 13, and 19. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection."

The examiner disagrees.

Kadyshevitch as described above, teaches irradiating an electron beam at an angle to strike the sidewall of a contact hole, and by using a positive surface charge the secondary electrons generated by the angled beam are attracted toward the surface to breakdown a surrounding metal gas to form a metal coating.

In addition, the applicant is respectfully directed to Kadyshevitch paragraph [0163], which states; The electron beam generated by gun 46 typically has a diameter and energy parameters that can be controlled as required by the application. The diameter may be adjusted to cover a single contact hole on the wafer, or expanded to irradiate several holes at once or to precharge the wafer surface. An adjustment range of 0.5-30 .mu.m in beam diameter is generally adequate for these purposes. The electron energy of the gun may be variable, typically between about 100 and 5000 eV, so as to cover both positive and negative charging domains of the materials in wafer 20.

One of ordinary skill would interpret from the reference above that, Kadyshevitch discloses directing an angled electron beam with an energy range between 100 and 5000 eV, which is included in the claimed range between 100 and 10,000 electron volts.

### **Argument 3**

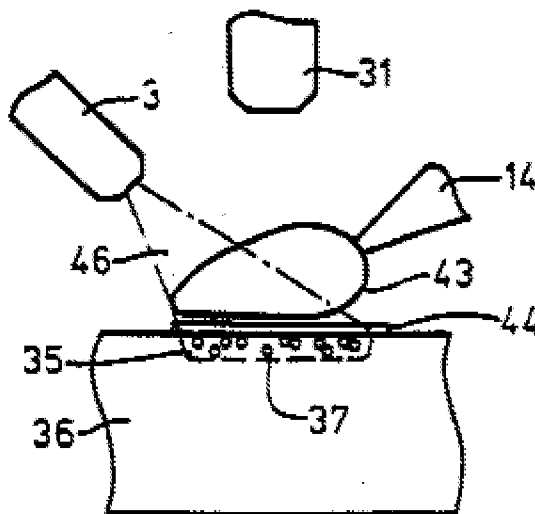
#### ***C. Regarding the §103(a) Rejection of claim 7***

The applicant states that, "Appellants submit that the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure" as defined in dependent claim 7. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection."

The examiner disagrees.

Kadyshevitch as described above, teaches irradiating an electron beam at an angle to strike the sidewall of a contact hole, and by using a positive surface charge the secondary electrons generated by the angled beam are attracted toward the surface to breakdown a surrounding metal gas to form a metal coating.

The appellant is also respectfully directed to Figure 6F below, which is described in Fuji at Col. 3, line 29-37.



**FIG. 6F**

One of ordinary skill would interpret from the reference above that, the energy beam 3 is directed at an angle of approximately 45 degrees relative to the surface of sample 36.

#### **Argument 4**

##### ***C. Regarding the §103(a) Rejection of claims 14 and 20***

The appellant states that, " Appellants submit that the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure" as defined in dependent claims 14 and 20. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

The examiner disagrees.

Kadyshevitch as described above, teaches irradiating an electron beam at an angle to strike the sidewall of a contact hole, and by using a positive surface charge the secondary electrons generated by the angled beam are attracted toward the surface to breakdown a surrounding metal gas to form a metal coating.

The appellant is respectfully directed to the discussion regarding claim 7 above, where the examiner interpreted from Figure 6F above that, energy beam 3 is directed

at an angle of approximately 45 degrees relative to the surface of sample 36. In addition, Fuji discloses that the sample is a semiconductor device. See Abstract

### **Argument 5**

#### ***C. Regarding the §103(a) Rejection of claims 2, 3, 10, and 17***

The appellant states that, "It is Appellants' position that the proposed combination of Kadyshevitch and Fuji does not render obvious independent claims 1, 8, and 15 and similarly does not render obvious dependent claims 2-3, 10, and 17. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

The examiner disagrees.

The appellant is respectfully directed to the response regarding claims 1, 8, and 15 above, where Kadyshevitch discloses irradiating an electron beam at angle to strike a sidewall, and by using a negative surface charge, the low energy secondary electrons generated by the angled beam are driven to the bottom of a hole; however, Kadyshevitch discloses using an electron beam to charge the sample surface either positively or negatively, where a positively charged surface would not drive secondary electrons to the bottom, but would provide an attractive potential and make them available for dissociation of a metal gas at the surface. Therefore, one of ordinary skill in the art would conclude that the Kadyshevitch invention does not exclude or teach

away from the use of positive charging, but merely shows certain advantages can be obtained by negative charging.

For the above reasons, it is believed that the rejections should be sustained.

***(11) Evidence appendix***

Missing. It is assumed that the appellant meant to include the appendix with a statement of "NONE"

***(12) Related proceedings appendix***

Missing. It is assumed that the appellant meant to include the appendix with a statement of "NONE"

Respectfully submitted,

PJ  
April 29, 2008

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